Monitoring Network of Fruit Production and Migratory Frugivorous Birds in Forests of the Pan-Japan Sea Area

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Monitoring Network of Fruit Production and Migratory Frugivorous Birds in Forests of the Pan-Japan Sea Area

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Abstract – Fruit production and frugivorous birds will be monitored in forests of Ishikawa Prefecture to determine roles of the birds as seed dispersers in the forest ecosystem. Studies of phenology and seed dispersal among sites with differing gradients of human impact will provide useful information for measuring seed dispersal success as influenced by the influx of frugivorous birds. We first describe a monitoring network established in Japan as a model of our study and then provide a guideline for the investigations.

I. Introduction

Recent decreases in the number of migratory birds in forests, including frugivores, have often been interpreted as resulting from deforestation in transient and overwintering areas of the birds due to human activity [1 - 3]. A seed dispersal system by frugivorous birds is one of the mutualisms essential to the maintenance of forest regeneration. The scarcity of fruit resources resulting from deforestation could have negative feedback since it would be followed by a decrease in the number of migratory birds which would, in turn, mean lower reproductive success of bird-dispersed plants to more severe deforestation.

Fruiting timing is one of the key factors influencing the reproductive success of bird-dispersed plants because large numbers of seed dispersers are available during the migration period. Fruiting events in Japan concentrate generally during fall-winter. Several studies have shown that seasonal patterns of fruiting of bird-dispersed plant communities were similar to seasonal patterns in the number of frugivorous birds, and the timing of peak occurrences tended to be later in sites at lower latitudes during fall-winter [4, 5] as shown in North America and Europe [6 - 11]. This suggests that frugivorous birds move in concert with local fruiting patterns of bird-dispersed plants which are regulated by various factors, it is probable that the birds migrate from north to south corresponding to the latitudinal change of fruit production. The correspondence of the fruiting season with migratory season might long ago have been established by the fruit-bird relationship.

The evolutionary ecological approach above is beneficial for forest conservation. For example, the brown-eared bulbul and some thrushes, major migratory frugivorous birds in East Asia, now overwinter in areas at higher latitude. This may have resulted not only from the higher temperature occasional by global warming but also from the fruit fecundity of cultivated plants. The northerly shift of overwintering areas of these birds could result in the decline of a succession of southern forests in which they previously overwintered. It is not enough, however, to conclude that a large-scale pattern of frugivorous bird migration corresponding to a global pattern of fruit production regulates the regeneration of bird-dispersed plant communities, because most of the phenological studies of migration of these birds and the fruiting of bird-dispersed plants were conducted for brief, specialized periods and studies of seed dispersal by migratory birds are scarce. A long-term observation of fruit production and migratory birds at more sites covering their migration areas, their breeding and overwintering sites is therefore needed, in addition to a basic study of seed dispersal.

The Japan Sea coast is believed to be one of the main migration routes of birds [3, 12]. Forests in the Hokuriku district are expected to be important transient sites for migratory frugivorous birds and fruit resources there are abundant and valuable. In this symposium, we introduce a monitoring network of fruit production and migratory frugivorous birds in forests, the Minori Network, this has already been established and is being developed throughout Japan. This study aims to establish key stations of this network in forests along the Japan Sea coast and to determine the degree of contribution of migratory frugivorous birds in the regeneration of bird-dispersed plants in those forests.

II. Monitoring of fruiting phenology and frugivorous birds (Minori Network)

The Minori Network was established in 2001 as a basis for the comprehensive and synthetic study, the roles of migratory birds and strategy of bird-dispersed plants on seed

dispersal systems with environmental change. Data will be collected by a common protocol centered around eight bases covering almost the entire country (Table I, Fig.1) and making good use of the latitudinal width of the Japanese islands. The network seeks to show a verifiable hypothesis that there are correlations between year-to-year fluctuations of visitations and movements of migratory birds and those of climatic factors and of fruiting phenology. The network is ultimately expected to be activated by promoting the participation of nonprofessional people such as naturalists and birdwatchers as well as semiprofessionals.

TABLE I
List of eight core members carrying out Minori project and their allotted district in Japan

Name	Affiliations	Allotted district
Keisuke Ueda	Rikkyo University	Project leader
Yoko Yamaguchi	Hokkaido Forestry Research Institute	Hokkaido District
Mitsuhiro Hayashida	Yamagata University	Tohoku District
Tomohiko Kamitani	Niigata University	Pan-Japan Sea Areas
Takeshi Wada	Osaka Museum of Natural History	Kinki District
Naohiko Noma	Shiga Prefectural University	Kinki District & Yakushima Island
Yosuke Kominami	Forestry and Forest Products Research Institute	Kyushu District
Takakazu Yumoto	Center for Ecological Research, Kyoto University	Yakushima Island

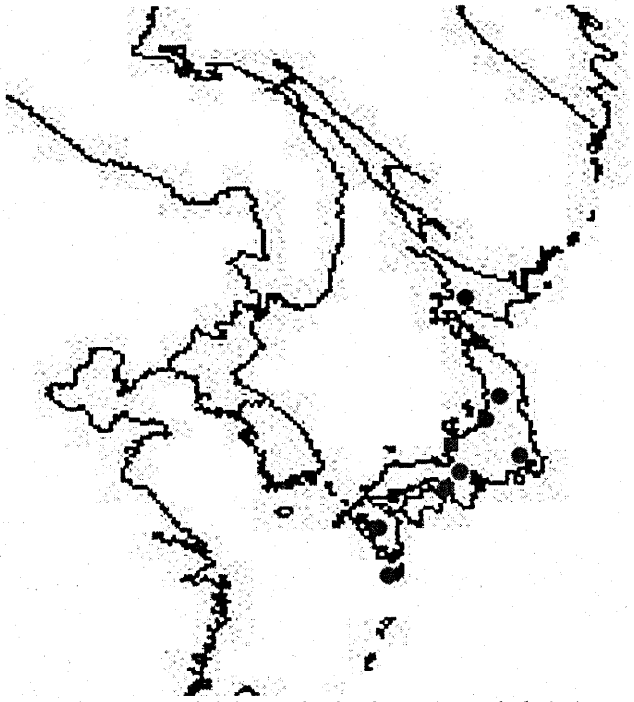

Fig. 1. Locations of eight monitoring bases (gray circles). A square shows a location of Kanazawa City.

III. Observation Manual of Minori Network

To compare time lag, amount of fruit production and number of frugivorous birds among sites, observations should be recorded on common data sheets (see Appendix 1a, b) as follows. The data of fruiting phenology and birds are acceptable by mail or fax to a manager.

A. Fruiting phenology

Study sites: primary forest, secondary forest, and plantation

Study period: biweekly census, 2nd and 4th week from September to January

Materials: fleshy-, arillated- and dry-fruited plants which have seeds surrounded by or attached to edible parts. One hundred and fifty-seven tree species representing 49 families and 36 grass species representing 14 families are the targets.

Method: A sample size of five individuals per species. Estimate number of mature fruits per individual regarding 100 fruits as one unit. If it is difficult to count the number of fruits per individual, this can be calculated by multiplying the number of fruits on selected branches.

B. Bird Census

Study sites and study period are the same as those of *Fruiting Phenology* above.

Materials: Frugivorous birds are defined as those which utilize edible parts of the fruit in their diets, thus both common frugivores and omnivores (major) and partially frugivores such as insectivores (minor) are included

Method: Record bird species and number of individuals by point-count method. Set at least 10 observation points regardless of positions of fruiting trees and record birds for at least 5 minutes at each point. Information of birds eating the fruit will be valuable.

IV. Investigation in Ishikawa Prefecture

A. Study sites

Nine study sites proposed in Ishikawa Prefecture are the primary or secondary forests listed in Table II: Kashima-no-mori, Kinjozan, Katano-Kamoike, Fushoji, Kanazawa-jo, Kakuma hills, Iozen, Mount Hakusan, Noto Hills (Wajima). The GIS system and meshed vegetation maps will provide useful information to select sites which are different in human impact. An observation plot (5×100 m) will be established in each site from the edge to the interior of the forest. In these plots, each 5 m distance will be marked by plastic poles, including 5×5 m sub-quadrats. A seed trap will be set in each sub-quadrat to collect fruits and seeds the birds excrete and regurgitate. The trap is made of three plastic poles and nylon mesh of with a collecting mouth 1 m^2 above the ground.

TABLE II
List of nine study sites proposed in Ishikawa Prefecture

Site	Location	Altitude	Vegetation	Succession type	Forested Area
Kashima-no-mori	Kaga City	~ 35 m	evergreen - broadleaf	primary	3 ha
Kinjozan	Kaga City	~ 66 m	evergreen - broadleaf	secondary	16 ha
Katano-Kamoike	Kaga City	~ 8 m	deciduous - broadleaf	secondary	170 ha
Fushoji	Kanazawa City	1 m	deciduous - broadleaf	secondary	20 ha
Kanazawa-jo	Kanazawa City	35 ~ 60 m	mixed (evergreen, deciduous) - broadleaf	secondary	30 ha
Kakuma	Kanazawa City	50 ~ 160 m	deciduous - broadleaf	secondary	74 ha
Iozen	Kanazawa City	~ 800 m	deciduous - broadleaf	primary	2940 ha
Mount Hakusan	Ishikawa Districts	~ 2700 m	deciduous - broadleaf, subalpine, alpine shrub	primary	14826 ha
Wajima	Wajima City	~ 200 m	deciduous - broadleaf	secondary	25 ha

B. Articles for Investigation

We will begin investigations in the study sites and collect baseline data on fruit production and migratory birds in April 2003 (articles 1, 2, 3). Basic studies of seed dispersal by birds will also be conducted to measure variables (parameters of seed dispersal) for estimating degrees of forest succession (articles 4, 5, 6, 7).

1. Seasonality of fruiting and migration (Minori Network)
2. Estimating mass of edible parts of fruits
3. Density of frugivorous birds
4. Estimating number and mass of fruit removed by birds
5. Estimating number and mass of seeds which have been dispersed
6. Estimating mass of seeds which have germinant abilities
7. Monitoring seedlings and saplings

Bird-dispersed plants having drupes or berries and frugivorous birds including pigeons and doves, bulbuls, waxwings, thrushes, flycatchers, white-eyes, and crows are targets of the study.

V. Future aims

Collection of the data on fruit and birds as simultaneously as possible among all sites will require the collaboration of more staff members and organizations. This means that it is essential for us to first construct a monitoring network in Ishikawa Prefecture.

Most migratory frugivorous birds seasonally cross boundaries between nations. Among them, thrush species have wide migration ranges; breeding in Siberia, passing in Primorsky, the Korean Peninsula, China and Japan [12], and overwintering in SE Asia [13, 14]. We believe the Minori Network will provide many useful hints on evolutionary ecology and forest conservation. In future we will probably expand the areas for greater understanding because the population dynamics of migratory birds especially in their transient sites is undoubtedly influenced by events in their breeding and overwintering sites such as climatic changes and deforestations [3, 15]. Ideally, an international monitoring network covering the Pan-Japan Sea area will be possible in the future.

Ishikawa Prefecture has unique features in its variety of vegetation and migratory birds due to its geographical and historic background. Migratory frugivorous birds have excellent potential as seed dispersers for bird-dispersed plants, which are the main components of forest communities in this region. A basic study of the seed dispersal system by migratory frugivorous birds is essential as one of the functions in maintaining a forest ecosystem. If this activity suffers under great deforestation by human activity, the seed dispersal success will decrease as human activity strengthens (Fig. 2). Studies on ecological services such as fruit-bird relationships will clearly contribute to forest conservation.

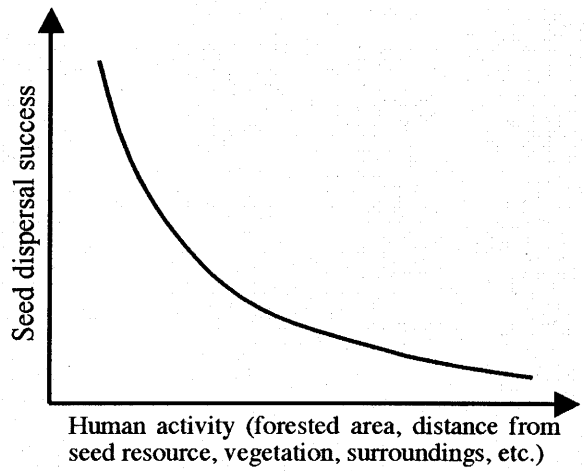

Fig. 2. A scheme of predicted correlation between seed dispersal success and human activity.

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Appendix 1. Data sheets for fruit (a) and bird (b)

a)

Data sheet (Fruit)
Site Date Observer

Habitat (dominant sp.)
1 Forest (broad-leaf conifer) (primary secondary) (canopy gap edge understory)
2 Grassland (alpine wetland secondary artificial) (isolated marginal)
3 Field (paddy field farm pasture orchard plantation)
4 Town area (roadside tree park tree garden tree)

Plant species #indv. (D.B.H. cm)
Number of estimated / indv
#branch Number of fruit / branch [a] Proportion of branch to canopy% [b] [a] / [b] × 100

1
2
3
4
5

Plant species #indv. (D.B.H. cm)
Number of estimated / indv
#branch Number of fruit / branch [a] Proportion of branch to canopy% [b] [a] / [b] × 100

1
2
3
4
5

Plant species #indv. (D.B.H. cm)
Number of estimated / indv
#branch Number of fruit / branch [a] Proportion of branch to canopy% [b] [a] / [b] × 100

1
2
3
4
5

b)

Data sheet (Bird)
Site
Date Weather Observer

Habitat (dominant sp.)
1 Forest (broad-leaf conifer) (primary secondary) (canopy gap edge understory)
2 Grassland (alpine wetland secondary artificial) (isolated marginal)
3 Field (paddy field farm pasture orchard plantation)
4 Town area (roadside tree park tree garden tree)

Observe point (#point)
starting : ~ finishing : duration min.
Bird sp. Number of Individuals behaviour (feeding, flying, rest, singing etc.)
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

* Record feeding materials and fruit (plant sp.)

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